

OCT 25 2006

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions of claims in the application.

**LISTING OF CLAIMS:**

1. (currently amended) A position sensor for sensing the position of a piston movable within a cylinder comprising:
  - a frame;
  - a spool rotatably mounted to the frame;
  - a cable windable about the spool and having a distal end adapted to be affixed to the piston, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the piston, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;
  - and a sensing means adapted to sense the position of the spool along its substantially linear path, wherein the sensing means includes a transducer mounted to the exterior of the frame and operably disposed to a target magnet movable in cooperation with the movement of the spool.
2. (canceled).
3. (currently amended) The position sensor of claim 1 wherein said transducer is a Hall-effect transducer ~~is mounted to the exterior of said frame.~~
4. (original) The position sensor of claim 1 wherein the spool travels along a linear path that is parallel to the rotational axis of the spool.
5. (original) The position sensor of claim 1 wherein the spool has a threaded engagement with the frame to cause the linear travel of the spool as the spool rotates.
6. (original) The position sensor of claim 1 wherein the spool has a threaded extension that is threadedly engaged with a threaded opening in the frame.
7. (original) The position sensor of claim 6 wherein the frame has a bushing having threads formed therein and the threaded extension has mating threads.

8. (original) The position sensor of claim 1 wherein the pitch of the threaded engagement causes the spool to travel a distance along its linear path about the width of the cable for each 360 degrees of rotation of the spool.

9. (original) The position sensor of claim 6 wherein said sensor includes a backlash mechanism to prevent backlash within the threaded engagement between the threaded extension and the frame.

10. (original) The position sensor of claim 9 wherein the backlash mechanism comprises a spring adapted to create a constant bias on the threaded extension to force the threaded extension against the threaded opening in the frame to prevent backlash therebetween.

11. (canceled).

12. (previously presented) The position sensor of claim 10 wherein the backlash mechanism comprises an arm pivotally affixed to the frame, the arm adapted to engage the threaded extension to create a constant bias on the threaded extension to force the threaded extension against the threaded opening in the frame to prevent backlash therebetween and wherein the sensing means comprises a sensor affixed to the arm to sense the position of the spool.

13. (original) The position sensor of claim 12 wherein there is a magnet affixed to the frame and the sensor comprises a Hall effect sensor that cooperates with the magnet to sense the position of the arm.

14. (original) The position sensor of claim 1 wherein a recoil spring biases the rotational movement of the spool to cause the cable to wind up on the spool.

15. (original) The position sensor of claim 14 wherein the recoil spring has one end affixed to the rotatable spool and another end is fixed with respect to the frame.

16. (previously presented) The position sensor of claim 15 wherein the recoil spring is a spiral spring having an outer end and an inner end and wherein the outer end is affixed to the rotatable spool and the inner end is fixed with respect to the frame.

17. (previously presented) The position sensor of claim 16 wherein the inner end of the spiral spring is affixed to a hub that is rotatably fixed with respect to the frame but is movable linearly along with the linear travel of the spool.

18. (original) The position sensor of claim 17 wherein the spool has a hollowed out area and the spiral spring is located within the hollowed out area within the spool.

19. (original) The position sensor of claim 18 wherein a cover plate covers the hollowed out area enclosing the spiral spring within the spool.

Claims 20 - 32. (canceled).

33. (original) The sensor of claim 1 wherein the sensing means further includes a magnet in moveable cooperation with the rotating spool and adapted to translate linearly proximate the Hall effect sensor such that the Hall effect sensor provides a position related signal relative to a position of the magnet.

34. (original) The sensor of claim 33 further comprising an adjustment mechanism to adjust an offset between the Hall effect sensor and the magnet.

35. (original) The sensor of claim 1 wherein the sensing means includes temperature sensitive elements, the sensor further comprising a temperature compensation element.

36. (original) The sensor of claim 35 wherein the temperature compensation element includes an electronic compensation circuit.

37. (original) The sensor of claim 35 wherein the compensation element comprises a temperature sensitive metal.

38. (previously presented) The sensor of claim 33 further comprising a reference Hall-effect chip mounted in fixed relation to the magnet and a circuit operable to compensate for a difference in outputs for the Hall-effect sensor and the reference Hall-effect chip.

39. (previously presented) A position sensor comprising:  
a frame;  
a spool rotatably mounted to the frame;  
a cable windable about the spool and having a distal end adapted to be affixed to the object to be sensed, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the object, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;  
and a sensing means adapted to sense the position of the spool along its substantially linear path, wherein the sensing means includes a Hall-effect transducer mounted to the exterior of the frame and operably disposed to a target magnet movable in cooperation with the movement of the spool.

40. (previously presented) A position sensor comprising:  
a frame having a bushing having threads formed therein;  
a spool rotatably mounted to the frame, the spool having a threaded extension having mating threads with the bushing and is threadedly engaged with the threaded bushing;  
a cable windable about the spool and having a distal end adapted to be affixed to the object to be sensed, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the object, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;  
and a sensing means adapted to sense the position of the spool along its substantially linear path.

41. (previously presented) A position sensor comprising:  
a frame;  
a spool rotatably mounted to the frame, the spool having a threaded extension having mating threads with the bushing and is threadably engaged with the threaded bushing;  
a cable windable about the spool and having a distal end adapted to be affixed to the object to be sensed, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the object, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;  
and a sensing means adapted to sense the position of the spool along its substantially linear path  
the sensor further including a backlash mechanism to prevent backlash within the threaded engagement between the threaded extension and the frame, the backlash mechanism comprises an arm pivotally affixed to the frame, the arm adapted to engage the threaded extension to create a constant bias on the threaded extension to force the threaded extension against the threaded opening in the frame to prevent backlash therebetween, and wherein the sensing means is affixed to the arm to sense the position of the spool.
42. (previously presented) The position sensor of claim 41 wherein there is a magnet affixed to the frame and the sensor comprises a Hall effect sensor that cooperates with the magnet to sense the position of the arm.
43. (previously presented) A position sensor comprising:  
a frame;  
a spool rotatably mounted to the frame;  
a cable windable about the spool and having a distal end adapted to be affixed to the object to be sensed, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the object, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

a recoil spring that biases the rotational movement of the spool to cause the cable to wind up on the spool, the recoil spring having one end affixed to the rotatable spool and the other end fixed with respect to the frame;

and a sensing means adapted to sense the position of the spool along its substantially linear path.

44. (previously presented) The position sensor of claim 43 wherein the recoil spring is a spiral spring having an outer end and an inner end and wherein the outer end is affixed to the rotatable spool and the inner end is fixed with respect to the frame.

45. (previously presented) The position sensor of claim 44 wherein the inner end of the spiral spring is affixed to a hub that is rotatably fixed with respect to the frame but is movable linearly along with the linear travel of the spool.

46. (previously presented) The position sensor of claim 45 wherein the spool has a hollowed out area and the spiral spring is located within the hollowed out area within the spool.

47. (previously presented) The position sensor of claim 46 wherein a cover plate covers the hollowed out area enclosing the spiral spring within the spool.

48. (previously presented) A position sensor comprising:  
a frame;  
a spool rotatably mounted to the frame;  
a cable windable about the spool and having a distal end adapted to be affixed to the object to be sensed, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the object, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

a recoil spring that biases the rotational movement of the spool to cause the cable to wind up on the spool, the recoil spring having an outer end affixed to the rotatable spool and an inner end affixed to a hub that is linearly movable but is prevented from rotational movement with respect to the frame, the hub being affixed to

the frame by means of at least one pin that extends between the hub and the frame and the at least one pin slidingly interfits in the hub to allow the hub to move linearly with respect to the frame;

and a sensing means adapted to sense the position of the spool along its substantially linear path.

49. (previously presented) A position sensor comprising:

a frame;

a spool rotatably mounted to the frame;

a cable windable about the spool and having a distal end adapted to be affixed to the object to be sensed, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the object, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

a sensing means adapted to sense the position of the spool along its substantially linear path, the sensing means including a magnet in moveable cooperation with the rotating spool and adapted to translate linearly proximate the Hall effect sensor such that the Hall effect sensor provides a position related signal relative to a position of the magnet.;

the sensor further comprising a reference Hall effect chip mounted in fixed relation to the magnet and a circuit operable to compensate for a difference in outputs for the Hall effect sensor and the reference Hall effect chip.

50. (previously presented) The position sensor of claim 1 wherein the sensing means includes an inductive transducer.

51. (previously presented) The position sensor of claim 40 wherein the sensing means includes an inductive transducer.

52. (previously presented) The position sensor of claim 41 wherein the sensing means includes an inductive transducer.

53. (previously presented) The position sensor of claim 43 wherein the sensing means includes an inductive transducer.

54. (previously presented) The position sensor of claim 48 wherein the sensing means includes an inductive transducer.

55. (new) A position sensor for sensing the position of a piston movable within a cylinder comprising:

a frame, the frame having a threaded opening in the form of a bushing having threads formed therein;

a spool rotatably mounted to the frame the spool having a threaded extension having mating threads with the bushing and threadedly engaged with the bushing;

a cable windable about the spool and having a distal end adapted to be affixed to the piston, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the piston, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

and a sensing means adapted to sense the position of the spool along its substantially linear path.

56. (new) A position sensor for sensing the position of a piston movable within a cylinder comprising:

a frame having a threaded opening;

a spool rotatably mounted to the frame, said spool having a threaded extension that is threadedly engaged with the threaded opening in said frame;

a cable windable about the spool and having a distal end adapted to be affixed to the piston, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the piston, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

and a sensing means adapted to sense the position of the spool along its substantially linear path, wherein said sensing means includes a backlash mechanism to prevent backlash within the threaded engagement between the threaded extension and the frame, wherein said backlash mechanism comprises a spring adapted to create a constant bias on the threaded extension to force the threaded extension against the threaded opening in the frame to prevent backlash therebetween and wherein the



backlash mechanism further comprises an arm pivotally affixed to the frame, the arm adapted to engage the threaded extension to create a constant bias on the threaded extension to force the threaded extension against the threaded opening in the frame to prevent backlash therebetween and wherein the sensing means comprises a sensor affixed to the arm to sense the position of the spool.

57. (new) The position sensor of claim 56 wherein there is a magnet affixed to the frame and the sensor comprises a Hall effect sensor that cooperates with the magnet to sense the position of the arm.

58. (new) A position sensor for sensing the position of a piston movable within a cylinder comprising:

a frame;

a spool rotatably mounted to the frame;

a cable windable about the spool and having a distal end adapted to be affixed to the piston, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the piston, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

and a sensing means adapted to sense the position of the spool along its substantially linear path, wherein a recoil spring biases the rotational movement of the spool to cause the cable to wind up on the spool and wherein the recoil spring has one end affixed to the rotatable spool and another end is fixed with respect to the frame.

59. (new) The position sensor of claim 58 wherein the recoil spring is a spiral spring having an outer end and an inner end and wherein the outer end is affixed to the rotatable spool and the inner end is fixed with respect to the frame.

60. (new) The position sensor of claim 59 wherein the inner end of the spiral spring is affixed to a hub that is rotatably fixed with respect to the frame but is movable linearly along with the linear travel of the spool.

61. (new) The position sensor of claim 60 wherein the spool has a hollowed out area and the spiral spring is located within the hollowed out area within the spool.

62. (new) The position sensor of claim 61 wherein a cover plate covers the hollowed out area enclosing the spiral spring within the spool.

63. (new) A position sensor for sensing the position of a piston movable within a cylinder, the sensor comprising a frame, a spool rotatably affixed within the frame about a central axis of rotation, the spool having a threaded extension extending therefrom and which is threadedly engaged through an opening in the frame, a feed point opening in said frame located in close proximity to the spool, and a cable passing through the feed point opening having an end adapted to be affixed to the piston and adapted to be wound around the spool to form a plurality of individual windings adjacent to but not overlapping each other, said spool adapted to move linearly along its axis of rotation as the cable is wound or unwound about the spool, wherein the linear movement of the spool through one full rotation is about one cable width, wherein the position sensor further includes a recoil spring having an outer end affixed to the spool and an inner end that is affixed to a hub that is linearly movable with respect to the frame but is prevented from rotational movement with respect to the frame and wherein the hub is affixed to the frame by means of at least one pin that extends between the hub and the frame and the at least one pin slidingly interfits in the hub to allow the hub to move linearly with respect to the frame.

64. (new) A position sensor for sensing the position of a piston movable within a cylinder comprising:

a frame;

a spool rotatably mounted to the frame;

a cable windable about the spool and having a distal end adapted to be affixed to the piston, wherein the spool rotates as the cable winds and unwinds in relation to the movement of the piston, said spool operable to travel along a substantially linear path in response to the rotational movement of the spool;

and a sensing means adapted to sense the position of the spool along its substantially linear path, wherein the sensing means includes a magnet in movable cooperation with the rotating spool and adapted to translate linearly proximate a Hall effect sensor such that the Hall effect sensor provides a position related signal relative to a position of the magnet, the sensing means further including a reference Hall-effect chip mounted in fixed relation to the magnet and a circuit operable to compensate for a difference in outputs for the Hall-effect sensor and the reference Hall-effect chip.